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Experiences in Designing Technologies for Honoring Deceased Loved Ones

William Odom, Daisuke Uriu, David Kirk,
Richard Banks, Ron Wakkary

Introduction

Material artifacts play highly significant roles in mediating people's rituals of honoring the lives of deceased loved ones and dealing with the grief that results from loss. They can powerfully evoke memories of the deceased and prompt reflections on mortality. Digital technologies are now a pervasive part of everyday life, and new issues are emerging as they intersect with people's everyday experiences of bereavement and their rituals of adapting to loss. We have undertaken two design investigations that focus on new ideas for creating technologies that could better support rituals of honoring deceased loved ones. Through our design-led research, we created working prototypes in two different contexts: Timecard was conceptualized and designed in the United Kingdom, and Fenestra was conceptualized and designed in Japan. Each of these projects represents efforts to design novel technologies for supporting domestic rituals of honoring in ways that are sensitive to the individual, social, and cultural contexts in which they were created. The core goal of this paper is to describe and reflect on these design efforts and in doing so to provide insights into creating technologies that enable the living to place and honor the dead in the context of their everyday lives.

In the following section, we review key research in both contemporary grief theory/therapy and interaction design to situate and support our design-led approach. We then describe insights that shaped Timecard and Fenestra and unpack the similarities and differences in design qualities of these artifacts that emerged during their making. We conclude by interpreting these reflections in terms of how these design artifacts place the dead in everyday settings and then describing implications for interaction design research.

- 1 See, e.g., Elisabeth Kübler-Ross, David Kessler, and Maria Shriver, *On Grief and Grieving: Finding the Meaning of Grief Through the Five Stages of Loss* (New York: Scribner, 2014); and John Bowlby, *Attachment and Loss Volume 1: Attachment* (New York: Basic Books, 1980).
- 2 See, e.g., Maurice Eisenbruch, "Cross-Cultural Aspects of Bereavement. II: Ethnic and Cultural Variations in the Development of Bereavement Practices," *Culture, Medicine and Psychiatry* 8, no. 4 (1984): 315–47; and Dennis Goss and Robert Klass, "Spiritual Bonds to the Dead in Cross-Cultural and Historical Perspective: Comparative Religion and Modern Grief," *Death Studies* 23, no. 6 (1999): 547–67.
- 3 See, e.g., Tony Walter, *The Revival of Death* (London: Routledge, 1994).
- 4 Elizabeth Hallam and Jenny Hockey, *Death, Memory and Material Culture* (London: Bloomsbury Academic, 2001).
- 5 Corina Sas and Alina Coman, "Designing Personal Grief Rituals: An Analysis of Symbolic Objects and Actions," *Death Studies* 40, no. 9 (2016): 558–69; see also Bronna D. Romanoff, "Rituals and the Grieving Process," *Death Studies* 22, no. 8 (1998): 697–711.
- 6 For an interaction design perspective on dispossession practices and coping with loss, see Corina Sas, Steve Whittaker, and John Zimmerman, "Design for Rituals of Letting Go: An Embodiment Perspective on Disposal Practices Informed by Grief Therapy," *ACM Transactions on Computer-Human Interaction* 23, no. 4 (2016): 21.
- 7 Janet Finch and Jennifer Mason, *Passing On: Kinship and Inheritance in England* (London: Routledge, 2013).
- 8 Jason Castle and William L. Phillips, "Grief Rituals: Aspects that Facilitate Adjustment to Bereavement," *Journal of Loss & Trauma* 8, no. 1 (2003): 41–71.
- 9 Mary Kohut, "Making Art from Memories: Honoring Deceased Loved Ones Through a Scrapbooking Bereavement Group," *Art Therapy* 28, no. 3 (2011): 123–31.
- 10 Sas, Whittaker, and Zimmerman, "Design for Rituals of Letting Go: An Embodiment Perspective on Disposal Practices Informed by Grief Therapy," *ACM Transactions on Computer-Human Interaction* 23, no. 4 (2016): 21.

Background and Related Work

Through their loss of a loved one or by facing mortality, people are profoundly shaped by their experiences of death. The grief resulting from bereavement can unsettle familiar practices, routines, and interactions. Vast social science literatures have investigated death, bereavement, and grief across cultures. A salient thread in this body of work makes clear that rituals of dealing with grief require sensitivity and delicate treatment on personal, social, and cultural levels.¹ Cross-cultural investigations of loss have argued that a multiplicity of approaches and interventions are needed to help the bereaved achieve personal rejuvenation and growth.²

Research in grief therapy has shown that personal rituals can play an important role in dealing with loss and developing a sense of emotional acceptance.³ Such rituals can positively shape attitudes toward loss and support the bereaved in transitioning to a new social role, even if these practices are culturally diverse.⁴

In synthesizing and interpreting a range of prior works in grief therapy, Sas and Coman articulate three categories of personal rituals for adapting to loss: *letting go*, *self-transformation*, and *honoring*.⁵ Rituals of letting go enable the bereaved to deal with and put to rest negative emotions by dispossessing artifacts that trigger painful memories of the deceased.⁶ Rituals for self-transformation trigger prospective thought in which the bereaved can process negative emotions and identify future goals. Honoring rituals nurture positive emotions by celebrating social bond(s) with the deceased. Such rituals help to preserve the memory of a person through objects and, in doing so, to support the bereaved in moving on from loss toward acceptance.⁷ Although objects used in honoring rituals take many forms, photos are among the most pervasive kinds of possession used in these practices.⁸ Furthermore, the practice of creating assemblages of photographs and other artifacts can function as a therapeutic ritual for honoring deceased loved ones and resolving grief.⁹

However, the proliferation of personal digital data in everyday life is introducing new challenges for rituals of adapting to loss. In particular, the lack of material presence and availability of digital possessions make the performance grief rituals more challenging.¹⁰ This issue can be particularly problematic for digital photos, which present the following challenges: (1) They lack the enduring presence and "causal durability" of paper photos, (2) they can be fragmented across several devices and online places, and (3) they require more maintenance and effort to be experienced.¹¹ These issues and the general question of how technology is intersecting with bereavement are evidently emerging topics of interest among the broader interaction design community.¹²

- 11 Nancy Van House, "Personal Photography, Digital Technologies, and the Uses of the Visual," *Visual Studies* 26, no. 2 (2011): 125–34. See also Daniela Petrelli and Steve Whittaker, "Family Memories in the Home: Contrasting Physical and Digital Mementos," *Personal and Ubiquitous Computing* 14, no. 2 (2010): 153–69; and, William Odom, John Zimmerman, and Jodi Forlizzi, "Placelessness, Spacelessness, and Formlessness: Experiential Qualities of Virtual Possessions," in *Proceedings of the 2014 Conference on Designing Interactive Systems*, eds. Ron Wakkary, Steve Harrison, Carman Neustaedter, Shaowen Bardzell, and Eric Paulos (New York: ACM, 2014), 985–94.
- 12 Prior interaction design research has explored issues such as the management of the deceased's digital possessions, the creation of support systems for the bereaved, and how digital systems shape practices of legacy-making. See Michael Massimi, William Odom, Richard Banks, and David Kirk, "Matters of Life and Death: Locating the End of Life in Lifespan-Oriented HCI Research," in *Proceedings of the 2011 SIGCHI Conference on Human Factors in Computing Systems*, eds. Desney Tan, Bo Begole, and Wendy Kellogg (New York: ACM, 2011), 987–96.
- 13 See, e.g., Tony Walter, Rachid Hourizi, Wendy Moncur, and Stacey Pitsillides, "Does the Internet Change How We Die and Mourn? Overview and Analysis," *OMEGA – Journal of Death and Dying* 64, no. 4 (2012): 275–302; and Jed Brubaker, Gillian R. Hayes, and Paul Dourish, "Beyond the Grave: Facebook as a Site for the Expansion of Death and Mourning," *The Information Society* 29, no. 3 (2013): 152–63.
- 14 See, e.g., Daisuke Uriu, Takahiro Ogasawara, Naohito Shimizu, and Naohito Okude, "MASTABA: the Household Shrine in the Future Archived Digital Pictures," in *Proceedings of the 2006 International Conference and Exhibition on Computer Graphics and Interactive Techniques*, ed. John Finnegan (New York: ACM, 2006), 151; and Wendy Moncur, Miriam Julius, Elise van den Hoven, and David Kirk, "Story Shell: The Participatory Design of a Bespoke Digital Memorial," in *Proceedings of the 2015 Participatory Innovation Conference*, eds. Rianne

Some investigations have specifically focused on how technologies mediate efforts to honor deceased loved ones. One area of work has investigated how social networking sites bring grieving practices out of public and private discourses and into the everyday lives of various social audiences.¹³ Others have focused on the design and study of tangible computational artifacts for supporting collocated and distributed rituals of mourning and remembrance.¹⁴ Drawing on these examples and many others, Moncur and Kirk offer a framework for designing digital memorials; they articulate the need to explore the role of technologies shaping practices for the post-self—how the identity of the departed is socially constructed, situated, and placed among the living.¹⁵ They also highlight the need to better take into account how personal and cultural rituals should influence the design of technologies for honoring the deceased. Such work sits against a backdrop of research among the interaction design community that more generally explores how reflection and reminiscence might be better supported with technology.¹⁶

In parallel to these works, we have seen a growing interest in the development of new knowledge through the construction of design artifacts. For example, Fallman posits the fundamental activity of design-led research as giving form to previously nonexistent artifacts to uncover new knowledge that otherwise would not have been revealed.¹⁷ Several other scholars have articulated design-oriented approaches that emphasize how designing interactive systems can develop nascent, underexplored research spaces.¹⁸ More recent research has pointed to the value of *bespoke* design interventions for deepening reflection on complex familial and personal orientations to ritual activities in domestic spaces.¹⁹ These works highlight the need for more examples of design-led research to develop a foundation from which future theoretical or empirical works can be framed and developed.

Collectively, these strands of research have made important contributions to understanding issues of death, bereavement, and rituals for adapting to loss. They also call attention to how complex this emerging space is for interaction design and make clear the need to develop different strategies that help sensitize it. Our work modestly tries to bring together key elements of these different strands. Specifically, we want to investigate how technologies can be designed to better support honoring rituals in everyday life. We do so by grounding our discussion in the design of two devices that exemplify new ideas for creating technologies to support rituals of honoring deceased loved ones.²⁰

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- Valkenburg and Jacob Buur (The Hague University of Applied Sciences, 2015), 470–77.
- 15 Wendy Moncur and David Kirk, “An Emergent Framework for Digital Memorials,” in *Proceedings of the 2014 Conference on Designing Interactive Systems*, eds. Ron Wakkary, Steve Harrison, Carman Neustaedter, Shaowen Bardzell, and Eric Paulos (New York: ACM, 2014), 965–74.
 - 16 See, e.g., David Frohlich and Rachel Murphy, “The Memory Box,” *Personal Technologies* 4, no. 4 (2000): 238–40; David Kirk and Abigail Sellen, “On Human Remains: Values and Practice in the Home Archiving of Cherished Objects,” *ACM Transactions on Computer-Human Interaction* 17, no. 3 (2010): 10; and Dan Cosley, Victoria Schwanda Sosik, Johnathon Schultz, S. Tejaswi Peesapati, and Soyoung Lee, “Experiences with Designing Tools for Everyday Reminiscing,” *Human-Computer Interaction* 27, no. 1-2 (2012): 175–98.
 - 17 Daniel Fallman, “Design-Oriented Human-Computer Interaction,” in *Proceedings of the 2003 SIGCHI Conference on Human Factors in Computing Systems*, eds. Gilbert Cockton, Panu Korhonen, Victoria Bellotti, and Tom Erickson (New York: ACM, 2003), 225–32.
 - 18 For example, William Gaver, “What Should We Expect from Research Through Design?,” in *Proceedings of the 2012 SIGCHI Conference on Human Factors in Computing Systems*, eds. Ed Chi, Kristina Höök, Susanne Bødker, and Dan Olsen (New York: ACM, 2012), 937–46; and John Bowers, “The Logic of Annotated Portfolios: Communicating the Value of Research Through Design,” in *Proceedings of the 2012 Conference on Designing Interactive Systems*, eds. Patrick Olivier, Peter Wright, Eli Blevins, and Elisa Giaccardi (New York: ACM, 2012), 68–77.
 - 19 See, e.g., David Kirk, David Chatting, Paulina Yurman, and Jo-Anne Richard, “Ritual Machines I & II: Making Technology at Home,” in *Proceedings of the 2016 SIGCHI Conference on Human Factors in Computing Systems*, eds. Allison Druin, Jofish Kaye, and Cliff Lampe (New York: ACM, 2016), 2474–86. See also William Odom, Abigail Sellen, Richard Banks, David Kirk, Tim Regan, Mark Selby, Jodi

Design Research Cases: Timecard and Fenestra

In this section we describe two devices that we created through a design-led approach. We selected these cases based on our intimate knowledge of their making. Timecard was designed in the United Kingdom and Fenestra in Japan, and these differing contexts shaped design decisions.²¹ However, both projects share some important similarities in their form, materials, and interactivity. In both designs we aimed to create computational artifacts that could enable people to “open up” by initiating and exploring the experience of honoring a deceased loved one’s life and then bring the experience “to a close” when desired. Previous work has described this dynamic aspect of honoring rituals as highly significant but not as well supported by digital technology.²² We also wanted to enable people to more easily engage in rituals of embodying or situating digital content, symbolic of deceased loved ones, in significant domestic artifacts and spaces. Prior research has highlighted that these kinds of actions can be valuable aspects of rituals adapting to loss over time.²³ However, this motivation has not been directly applied in the design of new technologies for supporting honoring rituals. These two factors shaped the design of both Timecard and Fenestra.

Timecard

We designed Timecard to explore how integrating digital photos along a timeline could enable people to construct, interact, and live with a tangible representation of a deceased loved one’s life as a form of honoring. Family members are able to upload digital photos via a web interface that transfers them to the Timecard device. When photos are uploaded, the person performing the upload must attribute a specific date detailing when the photo was taken; they also have the option of including additional textual metadata, which could take the form of personal reflections about the deceased. People can also select metadata that details historical events happening in the United Kingdom around the time period that the photo was taken (e.g., the United Kingdom votes to join the European Union (EU), in 1975). These design choices had two motivations. First, we wanted the bereaved ones to be able to record and embed their own personal narratives about specific instances in the deceased one’s life; such acts of honoring can play an important role in adapting to the loss.²⁴ Second, including historical metadata can help better contextualize what was happening in different life stages of the deceased for younger generations. These historical elements could trigger reminiscence and sharing



Figure 1
Initial prototype of Timecard. Photo: Microsoft Research. Used with permission.

Forlizzi, and John Zimmerman, "Designing for Slowness, Anticipation and Re-Visitation: A Long-Term Field Study of the Photobox," in *Proceedings of the 2014 SIGCHI Conference on Human Factors in Computing Systems*, eds. Matt Jones, Philippe Palanque, Albrecht Schmidt, and Tovi Grossman (New York: ACM, 2014), 1961–70.

- 20 For both Timecard and Fenestra, we aimed to create design artifacts that were highly resolved, final, and actual devices (rather than designing research "prototypes" that might be in-process or provisional). See, e.g., William Odom, Ron Wakkary, Youn-kyung Lim, Audrey Desjardins, Bart Hengeveld, and Richard Banks, "From Research Prototype to Research Product," in *Proceedings of the 2016 SIGCHI Conference on Human Factors in Computing Systems*, eds. Allison Druin, Jofish Kaye, and Cliff Lampe (New York: ACM, 2016), 2549–61.

of stories about the life of the deceased one by older generations with others, which can also function as a valuable social ritual of honoring.²⁵ We envisioned interactions with Timecard as an ongoing process as family members and friends incrementally constructed an increasingly rich and textured temporal representation of the deceased one's lifespan. With these interaction design choices, we wanted to open a space for reflection on each new element that was introduced into Timecard and, potentially, what its significance was in the context of the lives of both the deceased and the bereaved ones.

The main component of Timecard is an interactive touch screen (see Figure 1); photos are displayed here, and the timeline can be navigated by swiping left to go deeper into the past (i.e., earlier in the deceased one's life) or swiping right to go closer to the present (e.g., later in the deceased one's life). When a photo in the linear timeline is tapped, it expands to a full screen view, and any metadata attached is situated next to it. We encased Timecard in European Oak because we wanted its material aesthetics to evoke a sense of the warm qualities associated with other enduring domestic artifacts.

In our initial prototype, the touch screen remained visible and uncovered, so that it operated much like a digital photo frame (as in Figure 1). However, because of how and where it might be

Figure 2 (a and b)

Front-facing hinged doors added to Timecard. Photo: Microsoft Research. Used with permission.

- 21 For more details on earlier independent field studies of Timecard and Fenestra, see William Odom, Richard Banks, David Kirk, Richard Harper, Siân Lindley, and Abigail Sellen, "Technology Heirlooms? Considerations for Passing Down and Inheriting Digital Materials," in *Proceedings of the 2012 SIGCHI Conference on Human Factors in Computing Systems*, eds. Ed Chi, Kristina Höök, Susanne Bødker, and Dan Olsen (New York: ACM, 2012), 337–46.; and Daisuke Uriu and William Odom, "Designing for Domestic Memorialization and Remembrance: A Field Study of Fenestra in Japan," in *Proceedings of the 2016 SIGCHI Conference on Human Factors in Computing Systems*, eds. Allison Druin, Jofish Kaye, and Cliff Lampe (New York: ACM, 2016), 5945–57.
- 22 William Odom, Richard Harper, Abigail Sellen, David Kirk, and Richard Banks, "Passing On & Putting to Rest: Understanding Bereavement in the Context of Interactive Technologies," in *Proceedings of the 2010 SIGCHI Conference on Human Factors in Computing Systems*, eds. Elizabeth Mynatt, Keith Edwards, and Tom Rodden (New York: ACM, 2010), 1831–40.
- 23 For prior work exploring this theme from a grief therapy perspective, see Sas and Coman, "Designing Personal Grief Rituals"; and from an interaction design perspective, see William Odom, Richard Banks, and Dave Kirk, "Reciprocity, Deep Storage, and Letting Go: Opportunities for Designing Interactions with Inherited Digital Materials," *Interactions* 17, no. 5 (2010): 31–34.
- 24 Castle and Phillips, "Grief Rituals: Aspects that Facilitate Adjustment to Bereavement," *Journal of Loss & Trauma* 8, no. 1 (2003): 41–71.
- 25 For research on the therapeutic role of shared experiences of reminiscence in supporting social rituals of honoring the lives of departed loved ones, see Paul Rosenblatt and Carol Elde, "Shared Reminiscence About a Deceased Parent: Implications for Grief Education and Grief Counseling," *Family Relations* (1990): 206–10; and David E. Balk, "Death,



placed in domestic spaces (e.g., in prominent or central locations) this visibility ultimately made Timecard feel too present and conspicuous. Such visibility interfered with our goal of creating a device that could come into the foreground of domestic life when it was drawn on in an honoring ritual, but then would fade into the background when the ritual had come to an end; we considered the placement of the dead within the domestic space during both ritual and non-ritual activities. To make Timecard's touchscreen less obtrusive, we included hinged oak doors behind which the

Figures 3a and 3b

Timecard opened up for an honoring ritual (left) and placed among everyday artifacts and spaces (right). Photo: Microsoft Research. Used with permission.



screen could be hidden (see Figure 2). The finger holes allow the doors to be opened easily so that users can activate and engage with the underlying touchscreen interface. Collectively, these design decisions were intended to support a range of experiences with Timecard, from storing it away, to simply living with it among other things in the home, to actively engaging in rituals of honoring the deceased by constructing, exploring, and sharing a photographic timeline of their lifespan (see Figure 3).

Bereavement and College Students: A Descriptive Analysis," *Mortality* 2, no. 3 (1997): 207–20.

Figure 4

Fenestra's three wirelessly connected physical artifacts, candleholder, circular mirror, and photo frame, among other domestic artifacts. Photo: Daisuke Uriu.



Figure 5

Kisenan temple (Kamakura, Japan). Photo: Daisuke Uriu.

Fenestra

We designed Fenestra to explore how embodying digital photos in a computational artifact could support everyday practices of honoring the lives of deceased loved ones in Japan. The design of Fenestra's interaction and aesthetics drew inspiration from the *butsudan*, a Japanese Buddhist home altar (see Figure 4), as well as from symbolic forms commonly found in Japanese Buddhist temples. In Figure 4, a garment and plant are juxtaposed with the candleholder, circular mirror, and photo frame of Fenestra. During the initial part of our design process, we observed four households' practices with their *butsudan* in the Tokyo area and visited several traditional Zen Buddhist temples across Japan. These activities helped sensitize us to the symbolic forms, materials, and practices present in these sites. Circle and square shaped windows were common in many Buddhist temples we visited (see Figure 5). In Zen Buddhism, the circle symbolizes the afterlife paradise, whereas the square represents the lower (i.e., living) world. Candles also commonly populate altars and temples; candlelight symbolizes the journey of the deceased's spirit to the afterlife.



Figure 6
The Candle, Candlelight, and Framed photos
of Fenestra. Photo: Daisuke Uriu.

The three wirelessly connected artifacts of Fenestra—the mirror, photo frame, and candleholder (see Figure 6)—are designed as a visual “family,” each handcrafted from teakwood.²⁶ Family members can upload photos through a web service that then transfers them to Fenestra. The mirror is a custom-cut, circular piece of one-way mirror glass, which has an LCD display behind it. We gave the mirror a circular form as a subtle cultural reference to Zen Buddhism. The mirrored glass creates a slight reflection of the user’s face, overlaid onto a close up of a deceased loved one’s face when the circular screen is activated. We wanted to create this juxtaposition to potentially open a space of contemplative reflection on the relation of the viewer’s own life to that of the deceased—a quality of experience that seemed to commonly emerge with traditional butsudan altars. The photo frame consists of a tablet computer embedded in a wooden case. The photo frame wirelessly receives signals from the candleholder and mirror. The candleholder is embedded with sensors that detect variations in the candle flame movement and brightness. When a candle is lit, all sensors continuously send to the photo frame data regarding the brightness and movement of the candle’s flame. By using wireless connectivity, our goal was to support a wide range of possible configurations in the home. The candle could be moved elsewhere in the home, as could the other components of Fenestra. These design decisions were intended to allow mourners to engage in rituals that would interweave other symbolic and important artifacts with Fenestra over time. These design decisions are counter to extant practices of demarcating specific spaces within a Japanese home for ritual and remembrance of the deceased.

26 Fenestra’s design was in part inspired by an earlier project called ThanatoFenestra, an art installation that speculatively explored a potential future where bereaved family members could remember their ancestors by experiencing photographs projected onto a circular canvas. For more details on ThanatoFenestra, see Daisuke Uriu and Naohito Okude, “ThanatoFenestra: Photographic Family Altar Supporting a Ritual to Pray for the Deceased,” in *Proceedings of the 2010 Conference on Designing Interactive Systems*, eds. Kim Halskov and Marianne Graves Petersen (New York: ACM, 2010), 422–25.

We decided to use candlelight as the primary “input” because it offers a tangible way to bring up the digital photos, while not requiring additional interaction from the user. When a candle is lit in the candleholder, the photo frame shows images of the departed loved one (see Figure 6). We developed a computational script to generate cropped, circular, portrait-like images from these photos. These cropped images simultaneously would appear in the mirror when the photo was displayed in the photo frame.²⁷ Additional pairings of these photos and cropped images are displayed based on changes in the candlelight’s brightness and movement. If the candlelight shimmers from a slight breeze, a similar shimmering visual effect manifests across the photo’s image in the mirror. If the flame wavers more strongly, Fenestra cycles through photo pairings in a motion closely tied to the flame’s movement. As the candle dims over time, the photos do, too. When the candle goes out, all screens are dimmed and remain off. These decisions were motivated by our desire to leverage familiar material practices already associated with Japanese ceremonies and rituals used to honor the deceased. We also wanted to draw on candlelight as an unpredictable and finite input mechanism to emphasize that the act of meditating on the lives of deceased loved ones is a form of honoring that is somewhat unstructured and could eventually come to a close, in this case by extinguishing the candle.

Discussion and Conclusion

We have described the design-led processes undertaken in the United Kingdom and Japan to better understand how technologies could be designed to support honoring rituals. This work touches on complex, subtle, and diverse matters of individual and social rituals for honoring deceased loved ones, remembering their lives, and adapting to their loss over time.

At a high level, our design decisions for Timecard and Fenestra aimed to support a broad range of interactions and experiences, interwoven with domestic practices: They might serve as a rich resource for honoring rituals, be casually encountered against the backdrop of everyday life, or simply be stored away. In this work, we began an exploration of the enculturated and ritualized placement of remains. In the Japanese context, prominent (and enduring) placement is more commonplace, which shaped our decisions to design Fenestra in a form that allowed the living to move Fenestra among different domestic spaces and artifacts and, in so doing, to demarcate personalized places in the home for rituals and remembrance of the dead.²⁸ For UK homes, Timecard required a modified design to provide options for less prominence.

27 The cropped circular images are a reference to the *iei*—an image typically created by a third-party Japanese funeral company. The *iei* photo is always edited to depict a portrait of the departed against a neutral background; a print of it is then made, framed, and shown at the departed’s Japanese memorial ceremony. Because the *iei* photo is closely tied to formal ceremonies, we chose not to edit out the backgrounds of the cropped circular images to emphasize the everyday nature of Fenestra as a domestic technology. For more details on the phenomenon of the *iei* photo, see Robert John Smith, *Ancestor Worship in Contemporary Japan* (Palo Alto: Stanford University Press, 1974).

28 This decision parallels contemporary trends in Japan that indicate a broader social acceptance of less traditional and more personalized ritual practices of honoring deceased loved ones in the home. For more details, see Hikaru Suzuki, “Beyond Ancestor Worship: Continued Relationship with Significant Others,” *Death and Dying in Contemporary Japan* (2013): 141.

Such practices of layering and spatializing of remains have been noted by Kirk and Sellen, who demonstrate the ways in which memory-related artifacts might be distributed in a home. In this work, “deep storage” was invoked as a metaphor describing how cherished objects would be retained but kept from view or from persistent interaction, while other objects were interacted with in everyday practices (i.e., functional storage).²⁹ We saw the need for such flexible orientation to, and placing of, artifacts in the design of both devices.

The physical qualities of Timecard and Fenestra also allowed for digital materials symbolic of the deceased to be more fluidly situated near other significant artifacts, places, and people in the home. We explored how the materiality of memorial artifacts intersected with space; the design and the spatiality were interwoven to dynamically (re)configure relationships to the deceased.³⁰ Nonetheless, adjusting to loss and dealing with bereavement can unfold unpredictably over time. Our design decisions created technologies that persisted as invitations to enact an honoring ritual as needed or appropriate. In this way, Timecard and Fenestra offer examples of how digital technologies can be designed to allow the living to place memorial artifacts on their own terms and to support the “doing” of grief.³¹

Timecard and Fenestra also exhibited key differences, particularly in terms of how the devices displayed images of the dead on their respective screens. Timecard’s design evokes a linear conception of time by situating the deceased along a timeline representing her or his lifespan. Through the piecemeal actions of selection, placement, and curation of images (and possibly historical metadata to contextualize these images), the bereaved ones can generate a photographic timeline of the deceased one’s life. This design decision was intended to build on and mobilize prior research in grief therapy that highlights the value of constructing material photographic assemblages as mechanisms to process grief, to reminisce, and to share stories about the deceased.³² Importantly, Timecard’s photographic timeline is continuous and not bound solely to the life of the deceased. By enabling the bereaved ones to connect images of their own ongoing life with the departed, this design decision aimed to create a situated place for bridging the images of both the living and the dead across a broader temporal space that encompasses multiple lifespans.³³ In addition to supporting honoring rituals, these design decisions offered support for rituals of self-transformation, as the bereaved ones prospectively consider their own life in relation to the dead. This experience can arise from weaving together images of both

29 Kirk and Sellen, “On Human Remains: Values and Practice in the Home Archiving of Cherished Objects,” *ACM Transactions on Computer-Human Interaction* 17, no. 3 (2010): 10.

30 Hallam and Hockey, *Death, Memory and Material Culture*, (Bloomsbury Academic: London).

31 Sas, Whittaker, and Zimmerman, “Design for Rituals of Letting Go: An Embodiment Perspective on Disposal Practices Informed by Grief Therapy,” *ACM Transactions on Computer-Human Interaction* 23, no. 4 (2016): 21.

32 Mary Kohut, “Making Art from Memories: Honoring Deceased Loved Ones Through a Scrapbooking Bereavement Group,” *Art Therapy* 28, no. 3 (2011): 123–31; Castle and Phillips, “Grief Rituals: Aspects that Facilitate Adjustment to Bereavement,” *Journal of Loss & Trauma* 8, no. 1 (2003): 41–71; and; see also Jeanne Thibo Karns, “Scrapbooking During Traumatic and Transitional Events,” *Journal of Clinical Activities, Assignments & Handouts in Psychotherapy Practice* 2, no. 3 (2002): 39–47.

33 Designers increasingly see the need to develop technologies and adopt a long-term perspective on how they could be used across generations and on how stakeholders might be affected. See Batya Friedman and Lisa P. Nathan, “Multi-Lifespan Information System Design: A Research Initiative for the HCI Community,” in *Proceedings of the 2010 SIGCHI Conference on Human Factors in Computing Systems*, eds. Elizabeth Mynatt, Keith Edwards, and Tom Rodden (New York: ACM, 2010), 2243–46.

the living and the dead over time.³⁴ However, the timeline metaphor in Timecard's design requires people to input digital images to which they assign precise dates, potentially representing events that happened years in the past. This exacting, highly structured quality could produce unintended consequences for the bereaved ones if conflicting recollections emerged among the living regarding precisely when and what transpired at past events, and who is accountable for "correctly" recording them in the system.³⁵ Better understanding these concerns seems a crucial part of designing technologies that sensitively support rituals of honoring and self-transformation and, more generally, the persistence of a family's digital legacy across generations.

Fenestra represents a contrasting approach in which we leveraged candlelight as an unpredictable means of input to place and display digital photos of the deceased on its screens. Our intent was to cede control to the system to support meditative contemplation of the deceased as a form of honoring, much like what we observed in ritual uses of the butsudān. Fenestra places a cropped portrait image of the dead in juxtaposition to an image of her or him within a broader social context with the aim of supporting a range of ritualized experiences, from deep contemplation of the deceased to reflection on shared experiences. A momentary shimmering effect in the images of the dead when Fenestra detected candlelight flickers supported this goal further by redirecting attention toward the image of the dead (or other attendant material artifacts), as well as by emphasizing the ephemeral nature of the ritual itself. This approach exhibits a high degree of randomness and clearly contrasts with the precise and deliberate placing of images of the dead in Timecard. This strategy offers promise to support mindful contemplation of the dead while abdicating control. Yet, uncomfortable emotions also might emerge in encountering an image unexpectedly, evoking feelings of loss.

These insights point to key complexities in designing technologies to support honoring rituals in different individual, social, and cultural contexts. Our comparison of Timecard and Fenestra makes clear that enough structure is required to frame, organize, and place digital images of the dead in the everyday settings of the living. Yet, too much structure or openness might divert attention away from the ritual at hand and result in conflict over the memory of the deceased. Our work contributes new insights for navigating this complex threshold and for sensitively placing and honoring the dead among the living. Design decisions in Timecard and Fenestra critically shaped the placement of the dead among artifacts and spaces of the living, as well as through the devices

34 Such rituals can be important for the bereaved ones in continuing their social bonds with the dead, while also moving on with personal life goals—a notion discussed in Kenneth Doka, "Therapeutic Ritual," in *Techniques for Grief Therapy: Creative Practices for Counseling the Bereaved*, ed. Robert Neimeyer (New York: Routledge, 2012), 340–43.

35 Prior works have begun to describe social tensions emerging from discrepancies in digitally recorded narratives of past experiences and conflicting accounts of events that had transpired among people. See, e.g., Liam Bannon, "Forgetting as a Feature, Not a Bug: The Duality of Memory and Implications for Ubiquitous Computing," *CoDesign* 2, no. 01 (2006): 3–15; and William Odom, "Understanding Long-Term Interactions with a Slow Technology: An Investigation of Experiences with FutureMe," in *Proceedings of the 2015 SIGCHI Conference on Human Factors in Computing Systems*, eds. Woontack Wood and Kori Inkpen (New York: ACM, 2015), 575–84.

themselves. Comparing these designs has demonstrated the benefit of supporting flexible orientation and placement of memorial artifacts as the processing of grief by the living unfolds and changes over time. Our discussion has also revealed divergent ways that digital technologies can support the curation, placement, and experience of photographic assemblages of the dead in ritual practices of honoring and self-transformation. In this way, themes in the literature related to honoring the dead have been revealed in our design work, as have design insights that can be extended to the creation of future technologies that support the complex processes of adapting to the loss of a loved one by honoring their continued and evolving place in our lives after they are gone.

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